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COTTAGERS' SELF-HELP PROGRAM:

ENRICHMENT STATUS OF LAKES IN THE SOUTHEASTERN REGION OF ONTARIO 1991

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COTTAGERS' SELF-HELP PROGRAM ENRICHMENT STATUS OF LAKES IN THE SOUTHEASTERN REGION OF ONTARIO 1991

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TABLE OF CONTENTS

Acknowledgments

The acquisition of data on of our lakes would not be possible without the dedication of the volunteers who undertake the water quality sampling and other observations. We wish to acknowledge with appreciation their contribution to the self-help program. The information they help to provide contributes to the management and protection of our ecreational lake resource. We are especially grateful to the following organizations and individuals who have been responsible for a ten or more year record of participation in the program.

Ashby Lake Protective Association
Baptiste Lake Association
Bass Lake Cottage Association
Battersea-Loughborough Association
Big Rideau Lake Association
The Greater Bobs Lake Association
Bon Echo Provincial Park
Brule Lake - Mr. G. F. Carleton
Buck Lake Protective Association
Burridge Lake Cottage Association
Calabogie Lake Estates, Ltd.
Charleston Lake Provincial Park
Charleston Lake Ratepayers Association
Chimo Park Community Association
Chippego Lake - Mr. D. Buchan
Christie Lake Association
Crosby Lake Cottage Association
Crowe Lake Property Owners Association
Dalhousie Lake Association. Inc.
Davern Lake - Mr. R.S. Christy
Desert Lake Property Owners Association
Diamond Lake Cottagers Association
West Devil Lake Property Owners Association
Eagle Lake - Mrs. Rita Biddle, Mr. R. Langlais
Farren Lake Association
Gananoque Lake Property Owners Association
Glanmire Lake Cottage Association
North Shore Grippen Lake Cottage Association
Gunter Lake
Hay Bay - Mr. R. F. Sanderson
Indian Lake Cottage Association
Kennebec Lake Cottage Association
Lake St. Peter Rate Payers Association
Limerick Waterways Ratepayers Association
Little Silver Lake Property Owners Association
Lower Beverly Lake Protective Association
Mink Lake Betterment Association
Mississippi Lakes Betterment Association
Moira Lake Property Owners Association
Mosque Lake - Mr. J. O'Dette
Norway Lake Property Owners Association

Olmstead Lake - Mr. B. Briscoe
Opinicon Property Owners Community
Otter Lake - Dr. A. W. Khan
Otty Lake Association
Paugh Lake Cottage Association
Pike Lake Property Owners Association
Pinnacle Point Road Cottage Association
Red Horse Lake - Mr. J. T. Johnson
Saint Andrew Lake - Mr. R. H. Bain
Salmon Trout Lake Cottage Association
Shabomeka Cottagers Association
Sharbot Lake Provincial Park
Shawano Ratepayers
Silver Lake Environmental Protection Association
Skootamatta District Ratepayers
Steenburg Lake Community Association
Troy Lake - Mr. J. Arnold
Twin Sisters Lake Ratepayers Association
White Lake Water Quality Committee

Summary

This report is the 17th of a continuing series of reports on the Cottagers' Self-Help Program for the Southeastern Region of Ontario. The Self-Help program relies on the volunteer assistance of cottagers and other waterfront property owners to monitor the water quality of our inland recreational lakes. The monitoring consists of making regular observations on water clarity and collecting samples of water for determination of their algae content. Although water clarity and the prevalence of algae are only two measures of water quality, they provide a very good indication of the condition of a lake, especially in terms of its suitability for recreational use.

This report presents the monitoring results for the 108 lakes enrolled in the Self-Help program in the southeastern region of Ontario during 1991. The southeastern region includes Hastings and Prince Edward Counties and extends eastward to the Ontario-Quebec border. In general, water quality was found to be very good and improved over that from the previous year.

In addition, the report contains information to help cottagers protect their lake through such practices as maintaining their sewage systems in good order.

The Self-Help program enables the collection of information that is extremely important to lake water quality management. Detailed lake studies completed by the Ministry of the Environment are supplemented through the self-help program by a record of water quality observations that extend, in some cases, over a period of 20 years. This information, which would otherwise be impossible to obtain, allows for an assessment of normal variability in lake water quality and any changes that are occurring. Combined with other sources of information, it provides a basis for a better scientific understanding of our lakes and their protection.

SUMMARY

This report is the fifth of a continuing series of reports on the Cottagers' Self-Help Program for the Southeastern Region of Ontario. The Self-Help Program enlists the voluntary assistance of cottagers and others interested in the program to monitor the water quality of the inland recreational lakes. The monitoring consists of two measurements: observations on water clarity and collecting composite samples of water for determination of algal biomass. Although water clarity and the concentration of algae are only two measures of water quality, they provide a very good indication of the general condition of a lake, especially in respect to its suitability for recreational use.

This report presents the monitoring results for the lakes enrolled in the Self-Help program in the Southeastern Region of Ontario during 1991. In the Southeastern Region it includes Hastings and Prince Edward Counties and extends eastward to the Ontario-Quebec border. In general, water quality was found to be very good and improved over that from the previous year.

In addition, the report contains information on how to help cottagers protect their lake through good practices such as maintaining their septic systems in good order.

The Self-Help program remains the cornerstone of information that is extremely important to lake water quality management. Detailed data are collected less frequently by the Ministry of the Environment and supplemented through the Self-Help program in a record of water quality covering the past several years, in some cases, over a period of 20 years. This information, which would otherwise be impossible to obtain, allows for an assessment of normal variability in lake water quality and any changes that are occurring. Combined with other sources of information, it provides a basis for a better scientific understanding of our lakes and their protection.

INTRODUCTION

Water Quality and Lakefront Development

As a result of our geological legacy we are fortunate to have many hundreds, even thousands, of lakes. They are one of our most valuable natural resources. Because of this rich heritage, outdoor summer recreation and water are almost inseparably linked. A primary example of this linkage is the summer cottage. Increasing amounts of leisure time and growing affluence combined with easy accessibility of many lakes from urban centres of population have resulted in the development of their shorelines with summer cottages, permanent homes, campgrounds and vacation resorts.

Eutrophication

Ironically, development and the associated increase in recreational activity on our lakes can threaten their water quality and alter the very features of the lakes that attracted people to them in the first place. One of the greatest threats to water quality from development is an increase in the rate of supply of plant nutrients, particularly phosphorus and nitrogen, to the lake. These nutrients are fertilizers which stimulate the production of aquatic weeds and algae. Algae are microscopic green plants. One type of algae, phytoplankton, grow dispersed throughout

the water of a lake. Other types of algae grow attached to rocks, underwater plants and other submerged surfaces. Increased production of plants and algae give rise to increased productivity at all levels of the food chain up to and including fish. The nutrient enrichment of waters and the attendant increases in biological productivity are scientifically referred to as eutrophication.

A certain amount of nutrient enrichment or eutrophication is beneficial. Aquatic plants and algae are essential to the proper functioning of a healthy and well-balanced ecosystem. They provide food and shelter for fish and other aquatic life and through the process of photosynthesis replenish the vital supply of oxygen in the water. However, from a recreational use perspective, eutrophication can be undesirable. Increasing levels of phytoplankton cause a lake to become progressively greener and more turbid producing a decline in water clarity, while more nearshore weeds and other algae may interfere with swimming and boating. In a few cases, of extreme nutrient enrichment, algal blooms may occur. Algal blooms produce pea-soup scums on the surface that render a lake unsuitable for recreational activities, particularly those that involve body contact with the water such as swimming.

Algal blooms affect more than just the surface of the water. As the algae die, they sink and decompose using up the

limited supply of oxygen at the bottom of a lake. Deep water fish such as lake trout and other aquatic life that inhabit these depths are deprived of the oxygen that they need in order to survive. In shallow lakes oxygen depletion does not occur because wind induced mixing and photosynthesis keep the lake well oxygenated all the way to the bottom.

Sources of Nutrient Enrichment

Nutrients occur in a lake naturally. They originate in runoff from the surrounding land and forest, by resolublization from lake bottom sediments, by dustfall and in rain by precipitation directly on the lake surface. The supply, however, can be influenced by human activities. Any disturbance of the land or ground cover around the lake that exposes soil to erosion increases the supply of sediment bound nutrients in surface runoff. The use of manure and artificial fertilizers in agriculture and for residential lawns and gardens also increases the concentrations of nitrogen and phosphorus in runoff well above normal levels.

A major source of nutrients resulting from shoreline development is human and household sewage wastes. These wastes are rich in phosphorus and nitrogen. The most common form of sewage disposal in rural areas where cottage development occurs is the septic tank -tile field system. It provides for an underground release of a liquid effluent.

Although conventional septic tank - tile field systems are extremely effective at eliminating bacteria from sewage they are not always as effective in their ability to remove phosphorus and nitrogen. Nitrogen and phosphorus in sewage effluent released from a septic tank-tile field can travel via groundwater to reach an adjacent lake or water-course. Some of the tile field nutrients are absorbed by soil and removed through uptake by vegetation. The degree of removal is highly variable and depends on the type of soil, the depth to the water table, the nature of the bedrock, the amount of vegetation and the distance to the lake. In some situations, especially for shoreline development, phosphorus and nitrogen from sewage systems reaches the lake.

Limitations for Shoreline Development

Some lakes are naturally productive of weeds and algae. Even the best land use planning and shoreline development controls will not eliminate water quality problems associated with eutrophication. In other lakes, the growth of weeds and algae can be restricted by limiting the amount of phosphorus, nitrogen and other wastes entering a lake. In the largely forested and sparsely populated PreCambrian shield area of the province that makes up most of cottage country, some of the more obvious controllable sources of nutrient enrichment are those associated with shoreline development. On certain

sensitive lakes, restrictions and controls on development may be necessary.

LAKE SURVEYS AND WATER QUALITY MONITORING

Baseline Water Quality Surveys

In 1970 the Province initiated a comprehensive lake water quality survey program. Detailed baseline studies were carried out to inventory the physical, chemical and biological characteristics of our lakes with special emphasis on defining their sensitivity to nutrient enrichment. Over 300 lakes have been surveyed in the Southeastern region of the province alone. The southeastern region includes Prince Edward and Hastings Counties and extends eastward to the Ontario - Quebec border. It encompasses an area of 35,523 square kilometres and contains a population of 1.2 million.

Most lakes were found to have excellent water quality. Follow-up surveillance is necessary to maintain a current record of their water quality and to define and understand any changes or trends if they are developing.

Self-Help Program Lake Monitoring

The Province has neither the staff nor the resources to routinely visit more than a few dozen lakes per year. Therefore, the "self-help" program is used to obtain the assistance of lake associations, individual cottagers and other waterfront property owners to routinely monitor their lakes. Participants in the self-help program volunteer a half hour of their time every week or two while they are at their lake to make a measurement of water clarity and to collect a sample of water and arrange for its delivery to a Ministry of the Environment laboratory. The Ministry of the Environment analyzes the samples for their algae content, compiles the data and interprets the results.

METHODS

Sampling Equipment and Sample Delivery

Volunteers participating in the self-help program are provided with a Secchi disc and other necessary sampling equipment, a detailed set of sampling instructions, sample submission forms and return shipping material by the Ministry of the Environment. Arrangements are made for the cost of delivering water samples to be paid by the Ministry. In this way there is no direct out-of-pocket expenses incurred by the participants.

Secchi disc visibility depth measurements

Each volunteer is asked to make water clarity measurements at a single sampling location at a central or open-water area of their lake well removed from any localized shoreline influence. Water clarity measurements are made with a Secchi disc. A Secchi disc is a circular plate 20 cm in diameter that is painted with black and white opposing quadrants (Figure 1). The depth at which it disappears from view when slowly lowered into a lake is a standard and widely used measure of water quality. It is obviously one half the distance light travels through the water to the disc and back to the observer's eye. The depth of effective light penetration into the lake can therefore be approximated as twice the Secchi disc visibility depth. The region from the surface of the lake to the lower depth of effective light penetration is referred to as the euphotic zone. There is sufficient light throughout this zone to sustain photosynthesis and allow aquatic plants and algae to grow.

Water sample collections

A sample of water is collected at the same time and place as each water clarity measurement for determination of the

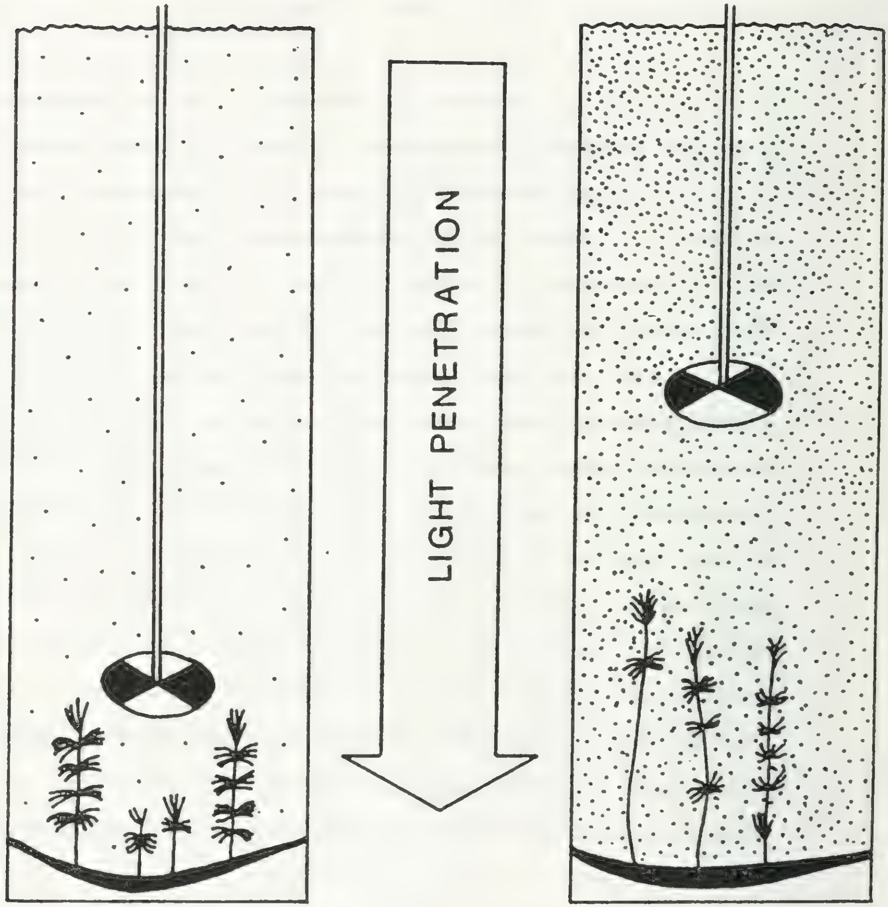

Figure 1: Diagram illustrating the use of a Secchi disc to measure water clarity. Greater visibility characterizes clear lakes having low algal densities (left panel) than productive lakes which contain high algal levels and have low light penetration (right panel)

amount of algae in the lake. The Secchi disc visibility reading is used to determine the lower limit of algae growth for the purpose of collecting the sample. The water sample is collected by lowering a bottle with a restricted opening in a weighted container to twice the Secchi disc visibility depth, i.e. the lower limit of the euphotic zone, and raising it at a uniform rate so that it is just full or almost full when it reaches the surface. In this manner a vertical composite sample equally representative of all levels of the euphotic zone is obtained. The water sample is preserved immediately after collection with 0.5 ml (five drops) of a one half per-cent magnesium carbonate suspension to prevent the degradation of the chlorophyll pigment and forwarded, usually within a day or two, to the Ministry of the Environment.

Ancillary Observations

Each sample is submitted with a sample submission sheet which documents the name of the sampler, the lake and location sampled, and the Secchi disc visibility depth measurement. Observations on the weather and water surface conditions are also provided on the sample submission sheet to assist with the interpretation of the results and to account for any anomalies in algal populations or water clarity caused by wind drift or other environmental factors.

Chlorophyll concentration determinations

The water samples that are received are filtered using a 1.2 micron pore filter. The residue is extracted with acetone and the chlorophyll concentration determined spectrophotometrically according to standard methods of the Ministry of the Environment. Chlorophyll is a green pigment found in all plants including algae. The concentration of chlorophyll in a water sample is a chemical measure of the amount of algae present in the lake at the time of sampling.

RESULTS

Self-help program participation

In 1991 157 volunteers sampled a total of 127 locations on 108 different lakes enrolled in the program in the southeastern region of Ontario. A total of 1552 samples were received averaging over 14 samples per lake. A number of lakes were represented by more than one sampling location. This is necessary for lakes that are divided into two or more distinct bodies of water such as Buck, Loughborough, or Moira and desirable for complex lakes that are comprised of a number of separate basins such as Baptiste, Big Rideau and Bobs which may act independently from a water quality point of view.

Of the 108 lakes enrolled in the 1991 self-help program, 96 were carried over from 1990, 11 were reintroductions after an absence during the previous year(s), while Westport Sand was new to the program for the first time in 1991.

Individual lake reports and tabular summary of results

The results of the Secchi disc visibility depth measurements and chlorophyll concentration determinations for the 1991 program are summarized as seasonal average values in Table 1. Results for each sampling date and location for the separate lakes are being distributed along with this report as individual lake printouts. In addition to the current year's data, the individual lake reports contain a tabular record of Secchi disc reading and chlorophyll concentration averages for previous years for which this data has been collected and summarized.

Lake Variability

Chlorophyll concentrations and water clarity may vary considerably at a given location from one sampling date to the next and over the growing season. It is not unusual for the maximum chlorophyll concentration to exceed two or three times the seasonal average. Unless a sampling program of sufficient frequency and duration to encompass any variability has been undertaken, a single mean may not

Table 1: Mean chlorophyll concentrations (ug/L) and Secchi disc visibility depths (m) 1991

LAKE	ID NUMBER	CHLOR	SECCHI	NOTE
ADAM	18-0033-001-01	3.2	3.4	
ALBION	17-0021-001-01	2.9	3.7	
ASHBY	18-3490-001-01	0.9	5.3	
BAGOT LONG	18-3490-041-01	2.9	3.6	
BAPTISTE	18-3490-002-01	2.3	4.7	
BASS	12-0017-001-01	1.5	5.3	
BEAVER - SOUTH BASIN	17-0031-002-01	2.0	1.8	
BENSON	12-0004-029-0+	8.9	3.6	1
BIG CLEAR (KENNEBEC)	17-0031-008-01	1.7	3.7	
BIG GULL (CLARENDON)	18-3430-003-01	1.9	4.3	
BIG RIDEAU	18-0033-006-01	2.1	3.3	
BIG RIDEAU - BRITON BAY	18-0033-005-01	2.3	4.5	
BLACK	18-0033-026-01	2.6	4.3	
BLACK BAY - PETAWAWA RIVER	18-4930-001-01	2.0	3.1	
BLACK DONALD	18-3490-043-01	1.1	6.1	
BOBS - BUCK BAY	18-0033-007-01	4.0	3.9	
BOBS - CROW BAY	18-0033-012-01	2.4	4.5	1
BOBS - EASTERN BASIN	18-0033-010-01	2.5	3.9	
BOBS - GREEN BAY	18-0033-011-01	1.6	5.3	
BOBS - MUD BAY	18-0033-008-01	4.3	3.8	
BOBS - WESTERN BASIN	18-0033-009-01	2.5	3.9	
BOIS DUR, LAC DU	18-4930-002-01	1.3	4.9	1
BOULTER	18-3490-009-01	2.0	3.5	
BRULE (WENSLEY)	18-3490-010-01	1.5	7.7	
BUCK - NORTH BAY	12-0004-002-01	2.4	4.9	
BUCK - SOUTH BAY	12-0004-004-01	2.7	5.9	
BUCKSHOT	18-3490-005-01	0.8	6.3	1
BURRIDGE	18-0033-014-01	2.0	4.7	
CAMP (LITTLE MACKIE)	18-3490-011-01	1.0	8.8	
CANONTO	18-3430-040-01	0.8	7.9	1
CASHEL	17-0021-002-01	0.9	5.4	
CHARLESTON - BIG WATER	12-0017-002-01	3.6	3.6	
CHARLESTON - GOOSE ISLAND	12-0017-006-01	3.3	3.6	
CHARLESTON - WESTERN WATER	12-0017-005-01	3.3	3.6	
CHIPPEGO	17-0035-002-01	3.4	3.6	
CHRISTIE	18-0033-015-01	4.4	4.5	
CLEAR (SOUTH CROSBY TWP.)	12-0004-006-01	1.9	4.1	1
CLEAR (SEBASTOPOL TWP.)	18-3690-001-01	0.8	5.7	
COLE	17-0035-017-01	4.1	2.8	
COLLINS - NORTH BASIN	06-0183-002-01	6.3	3.0	
COLLINS - SOUTH BASIN	06-0183-002-01	3.7	2.7	
CONSECON	06-0157-001-01	3.3	3.1	1
COPELAND	18-3490-056-01	1.9	6.4	
CROSBY (BIG CROSBY)	18-0033-016-01	4.4	3.9	
CROW	18-0033-017-01	1.7	5.3	
CROWE	17-0021-003-01	2.0	2.2	
DALHOUSIE	18-3430-009-01	1.8	3.8	
DAVERN	18-0033-033-01	3.3	5.0	
DEMPSEYS (VIRGIN)	18-3490-014-01	2.6	5.2	
DESERT	12-0004-009-01	2.3	5.0	
DEVIL	12-0004-010-01	2.0	5.1	
DIAMOND	18-3490-015-01	1.0	5.4	

LAKE	ID NUMBER	CHLOR	SECCHI	NOTE
DICKEY - NORTH BASIN	17-0021-004-01	1.6	3.8	
DICKEY - SOUTH BASIN	17-0021-005-01	2.3	4.4	
DRAPER	12-0004-012-01	1.2	3.9	
EAGLE	18-0033-019-01	2.0	5.4	
ELBOW	18-0033-035-01	3.4	3.1	
FARADAY (TROUT)	18-3490-042-01	0.7	5.2	1
FARREN (FARRELL)	17-0035-014-01	1.4	5.6	
GANANOQUE	12-0017-008-01	6.1	2.5	
GUNTER	17-0021-007-01	0.8	4.7	1
HAMBLY (SIVER)	17-0035-003-01	3.6	3.9	1
HAY	18-3490-054-01	4.6	2.0	
HAY BAY	17-0037-001-01	13.6	1.4	
HORSESHOE	17-0031-005-01	1.9	3.6	
INDIAN	12-0004-013-01	2.4	3.7	
JEFFREY	18-3490-047-01	1.3	5.3	1
JEFFREYS (OLMSTEAD)	18-4810-001-01	1.8	6.9	
JOEPERRY	17-0026-001-01	1.4	3.3	
KASHWAKAMAK	18-3490-010-01	1.6	3.3	
KENNEBED - EAST BASIN	17-0031-006-01	1.8	3.3	
KILLENBECK	12-0017-011-01	6.6	2.8	
LEO	12-0004-035-01	3.0	5.2	1
LIMERICK	17-0021-010-01	1.6	4.7	
LITTLE SILVER	18-0033-021-01	1.8	4.7	
LORWALL	18-3490-053-01	1.0	6.1	
LOUGHBOROUGH - EAST BASIN	12-0004-014-01	3.7	2.9	
LOUGHBOROUGH - WEST BASIN	12-0004-015-01	2.8	5.0	
LOWER BEVERLY	12-0017-012-01	3.9	2.8	1
LOWER BEVERLY - OAK BAY	12-0017-012-01	4.6	1.8	
LOWER HAY	18-3490-055-01	3.4	3.5	
MACKIE	18-3490-027-01	1.7	7.6	
MAZINAW	18-3430-011-01	1.1	4.5	
MEPHISTO	17-0021-015-01	1.5	6.5	
MINK	18-3690-006-01	1.8	3.5	
MOIRA - EAST BASIN	17-0026-002-01	5.7	2.6	
MOIRA - WEST BASIN	17-0026-003-01	10.5	1.7	
MOSQUE - NORTH & SOUTH	18-3430-017-01	1.3	4.4	
MOSQUE - WEST BASIN	18-3430-018-01	2.0	3.6	
MUSKRAT	18-4810-002-01	10.6	2.5	
NORWAY	18-3490-028-01	1.3	5.0	
OPINICON	12-0004-016-01	3.4	3.4	
OTTER	18-0033-024-01	1.8	5.5	
OTTER - NORTH BASIN	12-0004-023-01	1.7	3.9	
OTTER - SOUTH BASIN	12-0004-023-01	5.3	2.6	
OTTY	18-0033-025-01	3.0	4.0	
PAUGH	18-3690-009-01	0.8	5.7	
PEARKES	12-0004-036-01	3.2	3.9	
PIKE	18-0033-028-01	2.7	5.1	
REDHORSE - EAST BASIN	12-0017-020-01	2.2	4.1	
REDHORSE - WEST BASIN	12-0017-013-01	3.4	4.2	
ROBERTSON	18-3430-021-01	0.9	6.8	
ROBLIN	17-0016-007-01	1.5	4.1	
SAINT ANDREW	17-0035-006-01	3.6	3.1	
SAINT PETER	18-3490-031-01	2.2	4.2	
SALMON TROUT	18-3490-031-01	4.8	3.7	
SAND	12-0004-017-01	3.1	3.5	
SHABOMEKA	18-3430-034-01	2.3	5.2	

LAKE	ID NUMBER	CHLOR	SECCHI	NOTE
SHARBOT - EAST BASIN	18-3430-024-01	1.9	4.6	
SHARBOT - WEST BASIN	18-3430-023-01	1.6	3.9	1
SHAWENEGOG	18-3430-039-01	2.9	6.0	
SILVER	18-3430-027-01	2.3	4.2	
SKOOTAMATTA - WEST BASIN	17-0026-005-01	1.9	4.0	
SOUTH	12-0017-019-01	9.7	1.2	
STEENBURG	17-0021-011-01	2.1	4.2	
STOCO	17-0026-008-01	11.4	1.9	
STONES	18-3490-058-01	1.9	2.0	
TAIT	18-3490-036-01	1.4	4.0	
THIRTEEN ISLAND	17-0035-015-01	2.7	4.4	
TROY	12-0004-019-01	4.0	3.4	
TWIN SISTER - EAST BASIN	12-0021-012-01	2.5	3.4	
TWIN SISTER - WEST BASIN	12-0021-013-01	3.3	4.1	
UPPER RIDEAU	18-0033-030-01	6.3	2.4	
WEST	06-0163-001-01	6.3	1.2	
WESTPORT SAND	18-0033-040-01	3.0	3.2	
WHITE	18-3490-039-01	4.6	3.0	
WOLFE	18-0033-032-01	1.6	5.2	

1: The mean may not necessarily reflect seasonal conditions in these lakes as less than 6 sets of measurements were collected

be entirely representative of a lake's condition. Ideally, 12 or more observations at regular intervals from the end of May to the beginning of October (for example the Victoria Day weekend to the Thanksgiving weekend) should be collected. This is not always possible, depending upon a sampler's availability at the lake, and in many cases the data represent conditions during the summer months only. Therefore some discretion should be exercised in making comparisons between lakes and from one year to the next. Averages that were derived from less than 6 sets of observations are identified in the summary table and should be excluded from any type of comparative analysis.

Secchi disc visibility depths

In the absence of highly coloured water or inorganic turbidity, Secchi disc visibility depends primarily on the amount of algae or phytoplankton in the water. Lakes with low levels of algae are relatively clear and have high Secchi disc visibility depths. Lakes with abundant levels of algae are usually turbid or cloudy by comparison and have low Secchi disc readings.

For example, in the exceptionally clear and algae free waters of Brule and Camp (Little Mackie) Lakes, the Secchi disc visibility routinely exceeded 7 metres. On the other hand during periods of extremely high algal productivity

experienced in lakes such as Moira (west basin), South, Stoco and Hay Bay the visibility fell below 1 metre.
Most lakes possessed an average Secchi disc reading that fell within a range of 3.4 metres to 5.0 metres. The overall average reading for all 127 sampling locations was 4.2 metres.

Secchi disc visibility depth is only an approximate measure of biological productivity. It is influenced by other factors. These include how bright it is and the condition of the water surface at the time of the reading as well as the eyesight of the person taking the reading. Secchi disc measurements were made principally to determine the depth of the euphotic zone for collecting water samples for chlorophyll analysis. Chlorophyll is a more direct and practical measurement of algae and hence eutrophication than water clarity. When Secchi disc transparency is combined with chlorophyll concentration a better view of a lake's overall condition is obtained.

Chlorophyll concentrations

In general chlorophyll concentrations were low during 1991. The average concentration ranged from 0.7 ug/L (micrograms per litre) for Faraday Lake to 13.6 ug/L for Hay Bay. The

majority of lakes had averages between 1.7 ug/L and 3.4 ug/L while the overall average for all 127 sampling locations was 2.9 ug/L.

In contrast to the general situation, a few lakes experienced extremely high levels of chlorophyll lasting from a few days to several weeks. In terms of practical significance, water use impairment is more directly related to these peak concentrations than to annual or seasonal averages. Concentrations in the range of 20 ug/L to 30 ug/L are indicative of algal blooms and sometimes coincide with reports of nuisance accumulations of algae. Concentrations in this range occurred only in a few of the more productive lakes.

These included Stoco, South, Moira and Muskrat Lakes and Hay Bay.

Classification of Lakes

Lakes are classified on a continuously rising trophic (nutrient enrichment) scale according to their biological productivity. Traditionally, trophic state classification involves narrative descriptions of various factors and manifestations of enrichment such as nutrient concentrations, water transparency, profiles of dissolved oxygen with depth, the presence or absence of algal "blooms", the numbers and

kinds of plants and animals inhabiting the lake and even the physical dimensions of the lake itself. At the nutrient poor end of the scale are ***oligotrophic*** (unenriched) lakes and at the high end, ***eutrophic*** (enriched) lakes.

Oligotrophic lakes are characterized by low levels of chlorophyll and exceptionally clear water. They are usually deep lakes (more than 30 m). The shoreline is sparsely populated with aquatic plants. A stable fish population, often lake trout, provides a fair angling catch. The lake is well suited for a wide variety of recreational pursuits.

In contrast, ***eutrophic*** (enriched) lakes are more productive with higher concentrations of phosphorus and chlorophyll and poorer water clarity. Typically these lakes are shallow (less than 10 m) and often weedy and muddy. Fish populations do not include lake trout but may contain other sports species such as pickerel and bass. Angling success is generally better than for oligotrophic lakes since a more productive lake can sustain a larger population of fish. There is a good probability of one or more algal blooms developing in late summer or early fall. Under conditions of advanced eutrophy, the lake may experience recurring blooms throughout the growing season.

Mesotrophic (moderately enriched) lakes occupy an intermediate position in the classification scheme. They are intermediate with respect to depth, chlorophyll concentration, water clarity, and weeds. They may contain both warm and cold water fish populations.

While changes from trophic state do not occur at sharply defined stages, numeric criteria are useful in giving dimension to this classification scheme. The mean values for Secchi disc visibility depths and chlorophyll concentrations (Table 1) can be used to compare the lakes amongst themselves and to rank them according to their nutrient enrichment or trophic status.

Table 2: Ministry of the Environment Secchi disc - chlorophyll Lake Enrichment Classification Scheme.

Enrichment Status	Secchi disc (m)	Chlorophyll (ug/L)	Number of lakes
oligotrophic	>5	<3	29
mesotrophic	3 - 5	3 - 6	87
eutrophic	<3	>6	11

The simple allocation of a lake to a trophic state category based on solely one parameter may be of limited value. A lake that is classified as oligotrophic by its Secchi disc visibility may show signs of eutrophy based on other

characteristics. For the purpose of the above table, a body of water was classified as oligotrophic only if both the mean Secchi disc depth was greater than 5 metres and the mean chlorophyll concentration less than 3 ug/l. Similarly it was classified as eutrophic only if the mean Secchi disc depth was less than 3 metres and the mean chlorophyll concentration was greater than 6 ug/L. All other lakes were classified as mesotrophic. In this way, the results of the 1991 Self Help water quality monitoring program indicate that 29 water bodies are oligotrophic and 11 are eutrophic. All the rest of the lakes are categorized as mesotrophic. A comparable distribution of lakes amongst the trophic state categories has occurred in previous years. Lakes that are borderline between categories may change classification from one year to the next owing to slight changes in their water quality between years.

Classification as eutrophic does not necessarily imply use impairment. As indicated above use impairment is more closely related to the occurrence and intensity of algal blooms than by seasonal average chlorophyll concentration or Secchi disc visibility depths.

Many oligotrophic lakes are gems of pristine beauty that offer little recreational opportunity beyond swimming and boating. Some eutrophic lakes are extremely valuable because of their ability to provide excellent fishing.

LAKE PROTECTION

The Province has the responsibility to ensure the proper management of the resources that we jointly share in Ontario including our provincial waterways. The Ministry of the Environment sets limits on the quantities and concentrations of wastes that can be discharged to lakes and rivers. It also regulates the design and installation of private waste disposal systems such as septic tank - tile beds. In many parts of the province, the actual inspection and final approval of these systems is delegated to a local Health Unit.

The Ministry of the Environment also plays a proactive role in the protection of our waters through the process of land use plan review. Data provided through water quality surveys and the self-help program have been instrumental in establishing guidelines for the capacity of lakes to accommodate shoreline development. This information is used by local and regional planning agencies in formulating land use policies for Official Plans and zoning by-laws that regulate future lakefront development.

Existing waterfront property owners can also take individual responsibility in protecting their lake and its environment. The following is a list of practices that can be adopted to prevent or remedy adverse impacts of the residential use of

shoreland. Most of these measures are aimed at minimizing the potential for additional nutrient inputs to the lake.

1. New cottage construction and septic tank systems should be set well back from the lake. This practice allows phosphorus in runoff and in leachate from tile fields to be absorbed by soil and taken up by vegetation rather than reaching the lake. Set-backs have the additional advantage of preserving the natural scenic beauty of the shore by preventing development from intruding unnaturally upon the lake.

2. Building site preparation and construction activities should be carried out in a manner that minimizes disruption to the soil and vegetation on the property. All areas that are exposed during construction should be replanted as soon as possible to prevent runoff and erosion.

3. Sewage disposal systems must be constructed and installed in compliance with Provincial Regulations and should be properly maintained. Septic tanks should be pumped out periodically to remove accumulated solids. If they are not pumped out the solids can clog the tile bed and cause the system to back up. The area over the tile bed should be left open to the sun and wind to encourage evapotranspiration. Protect the tile bed from compaction

by vehicles and traffic including snowmobiles. If foul odours are noticed or there are signs of excessive moisture and surfacing of water on the tile field, contact the local Ministry of the Environment or Health Unit office for advice.

4. Practice water conservation to avoid overloading your sewage disposal system. Automatic dishwashers and washing machines use large volumes of water which can place a strain on tile fields. Take laundry back to the city for washing and do dishes by hand in the sink. Automatic dishwasher detergents have a high phosphate content and their use at a cottage should be avoided.

5. The shallow, near-shore, "littoral" zone supports most of the plant and animal life in a lake. Disruption of any part of this ecosystem threatens the entire cycle of life in the lake. In particular, habitat for fish and wildlife may be destroyed. A regulation enacted under the Public Lands Act requires a permit from the Ministry of Natural Resources (MNR) for any shoreline work. This includes cutting weeds, stabilizing banks, removing rocks or stumps from the water, building a dock or dredging. The permit is free and application forms are available from district offices of the MNR.

6. Maintain a zone of natural vegetation (trees and shrubs) as a protective buffer between lawns and the lake or leave your entire lot in a natural state. If you must have a lawn do not over fertilize it as the runoff could contaminate your lakefront.

7. If your property has been cleared of its natural vegetation, have your cottage association join MAPLE (Mutual Associations for the Protection of the Lake Environment), a volunteer organization that helps individual landowners rehabilitate their shorelines. For more information or a brochure on the program please contact MAPLE, c/o Box 271, Perth, Ontario, K7H 3E4

8. Help to ensure the continued enrollment of your lake in the self-help water quality monitoring program. On many lakes, cottagers' associations have been instrumental in coordinating self-help efforts and ensuring continuity of participation in the program. In addition to collecting scientific data on your lake, participation in the program helps to build an understanding of lake ecology and encourages an appreciation of the importance of lake protective measures.

By adopting the above measures everyone can play a role in protecting and preserving the future of their lake.